Seminar Begins at 9:00AM

Air Traffic Control Seminar

Introduction

Hosted by Gano Chatterji, UARC and Bill Preston, Perot Systems Government Services

NASA Ames Research Center

Moffett Field, California

September 5/6, 2007

Seminar Welcome

- **Safety Briefing**
- **Welcome by Dr. Tom Edwards,**
  NASA Ames Director, Office of Aeronautics

Seminar Objectives:

- **Provide an understanding of the existing US Air Traffic Control System with an overview of operations at:**
  - **Air Traffic Control Towers (ATCT)**
  - **Terminal Radar Approach Controls (TRACON)**
  - **Air Route Traffic Control Centers (ARTCC)**
  - **Oceanic Control (at selected ARTCCs)**
  - **Air Traffic Control System Command Center (ATCSCC)**

Seminar Objectives: (cont'd)

Participants Will Gain an Understanding of:

- **Controller's Duties and Responsibilities**
  - **For each type of facility**
- **Separation Requirements**
  - **For each type of facility**
- **Tools and Equipment Used by ATC**
- **The Traffic Management System**
  - **Structure**
  - **Programs**
  - **Equipment**
- **New ATM Technologies and Procedures being introduced into operations.**

Presenters:

- **NASA Ames:**
  - Bill Preston, PSGS, Airspace Systems Program
  - Gano Chatterji, UARC, Code AFM
  - Harry Swenson, NASA Ames, PI NGATS-ATM Airspace Project
- **FAA:**
  - Greg Kingery, San Francisco ATCT
  - Mike Artist, Air Traffic Control System Command Center
  - Ed Wilson, Oakland ARTCC, Oceanic Operations
  - Patty Daniel, Northern California TRACON, Airspace & Procedures
  - Rick Coté, Northern California TRACON, Airspace & Procedures
  - Jim Meadows, Oakland ARTCC, Airspace & Procedures
  - Jim Spillane, Oakland ARTCC, Traffic Management Unit

ATC Seminar Schedule:

Wed, September 5th

9:00AM	Introduction – Bill Preston and Gano Chatterji
9:15AM	NAS ATC Operations Overview – Bill Preston
10:00AM	Tower Operations – Greg Kingery, SFO ATCT
Noon	Lunch (not provided)
1:00PM	Traffic Management Operations– Mike Artist, ATCSCC
3:00PM	Oceanic Operations – Ed Wilson, ZOA Oceanic
5:00PM	Close

Thu, September 6th

9:00AM	NASA NextGen ATM-Airspace Project Overview – Harry Swenson
10:00AM	TRACON Operations – Rick Coté, Patty Daniel, NCT
Noon	Lunch (not provided)
1:30PM – 2:15PM	NASA Projects Meeting
2:30PM	En Route Operations– Domestic Radar
	– Jim Meadows, Oakland ARTCC
	– Jim Spillane, Oakland ARTCC Traffic Management Unit
5:00PM	Close

Seminar Plan

- Sessions scheduled from 9am to 5pm
- Refreshments/snacks in AM and PM
- Lunch not provided (Ames Deli and McDonalds are options at Ames)
- Videotaping of presentations
- During presentations, questions are encouraged (please use microphone)
- “Parking Lot” issues
- All presentations will be available online

Acknowledgements

The starting point for this series of presentations was the ATC Seminar prepared by Barry Scott and Jim McClenahan of the FAA. Information presented in this seminar has been updated and expanded by our presenters.

Special thanks to all of our FAA presenters for their work preparing and presenting these briefings.

Acknowledgements

- **Thanks to Jeff Schroeder, Lynda Haines and their staff for support of this seminar.**
- **Thanks to Riana Delossantos, Angela Boyle, Melinda Gratteau, Leslye Mogford and Sheryl Wold for seminar logistics support.**
- **Thank YOU for attending.**

NASA Ames -FAA Collaboration

- **CTAS**
- **TMA**
- **Tailored Arrivals**
- **NextGen**

- **FAA Support of familiarization of Ames personnel with ATC Operations:**
  - Seminar
  - Air Traffic Facility visits

Introduction to Air Traffic Control

- National Airspace System
- Air Traffic Control System
- Federal Aviation Administration
- Regulations, Directives and Rules

Web References

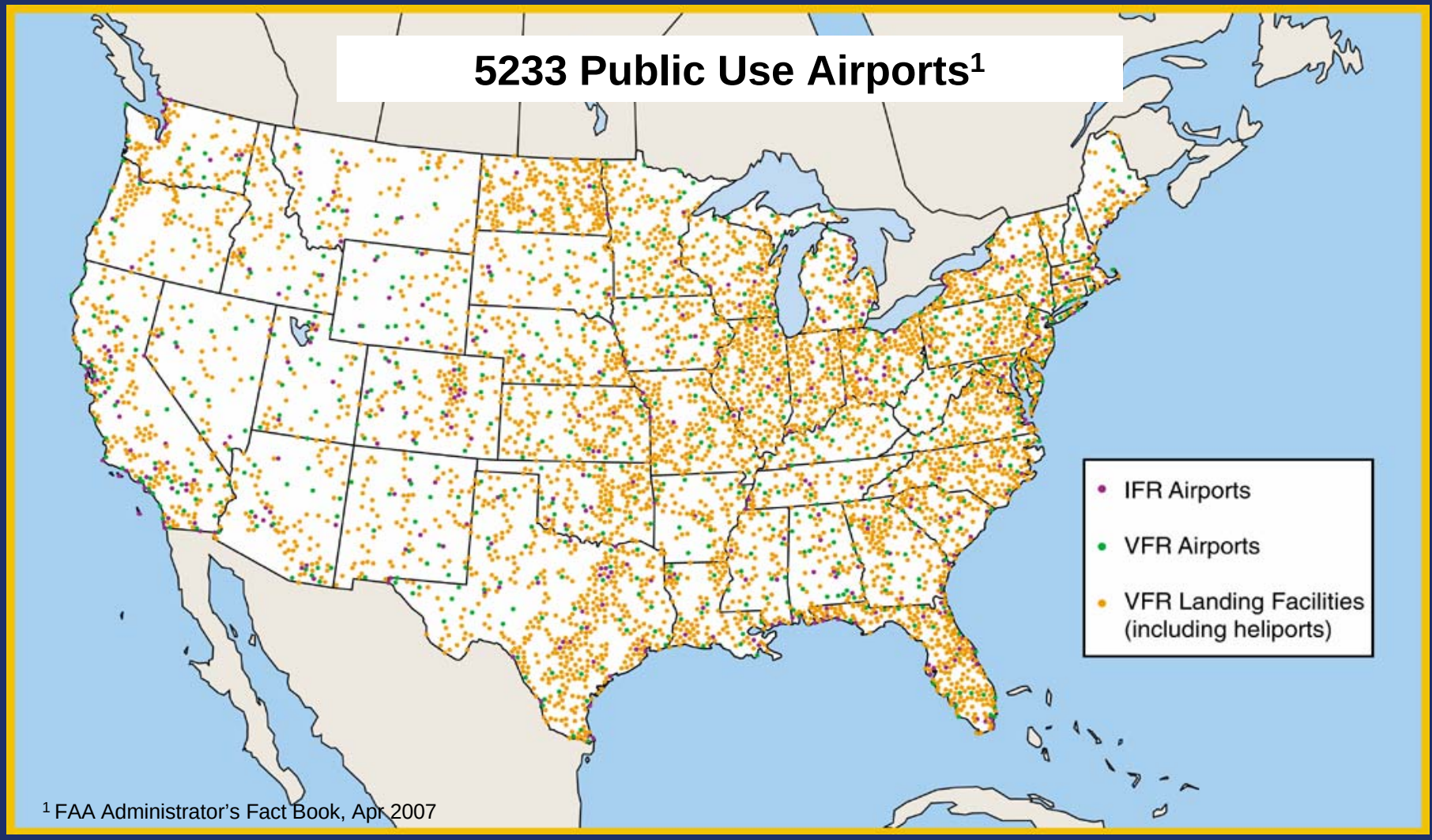
- **FAA reference links:**
  - FAA Main Website: http://www.faa.gov
  - FAA AT Publications: http://www.faa.gov/atpubs/
  - ATCSCC Web: http://www.fly.faa.gov/Products/products.jsp
  - ATO Online: http://ato.faa.gov
  - FARs: http://www.faa.gov/regulations_policies/
- **Upon completion of this seminar, briefings shown will be available online at:**
  - http://as.nasa.gov/atcseminar/

National Airspace System (NAS)

A network of airspace, air navigation facilities, equipment, services, airports or landing areas, aeronautical charts, information services, rules, regulations, procedures, technical information, personnel and material. Included in the NAS are system components shared jointly with the military.

- **Over 609,000 active pilots in the US**
- **Operating more than 280,000 aircraft, anything from large commercial aircraft to small private airplanes, helicopters, balloons and other craft.**

National Airspace System - Airports



[1] FAA Administrator's Fact Book, Apr 2007

National Airspace System (NAS)

Airports:

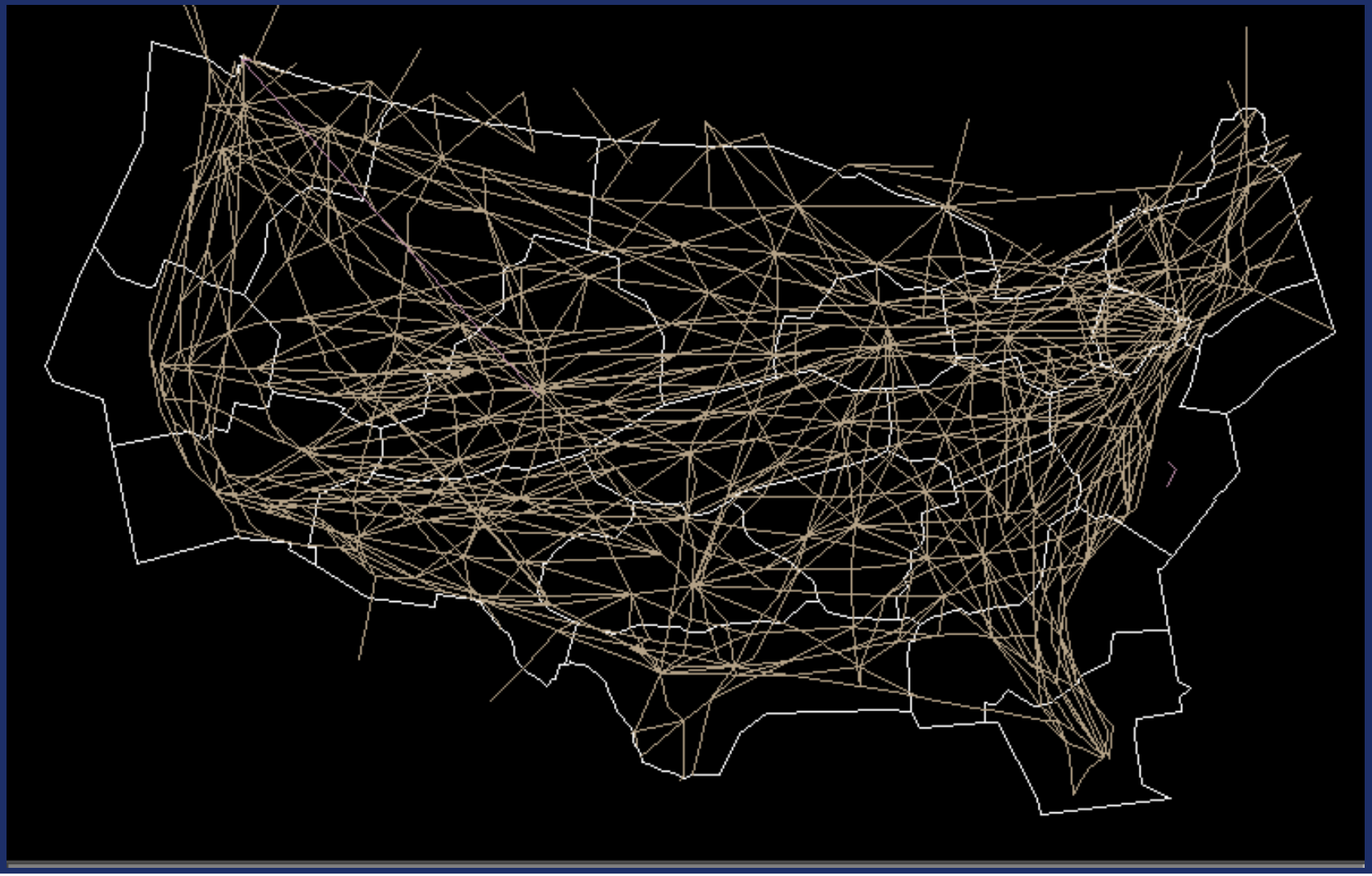
- **19,983 Airports in the US (including military and private fields)**
  - Public Use 5,233
  - Private Use: 14,757
- **Certificated airports*: 604 Civil**

Operations (CY05):

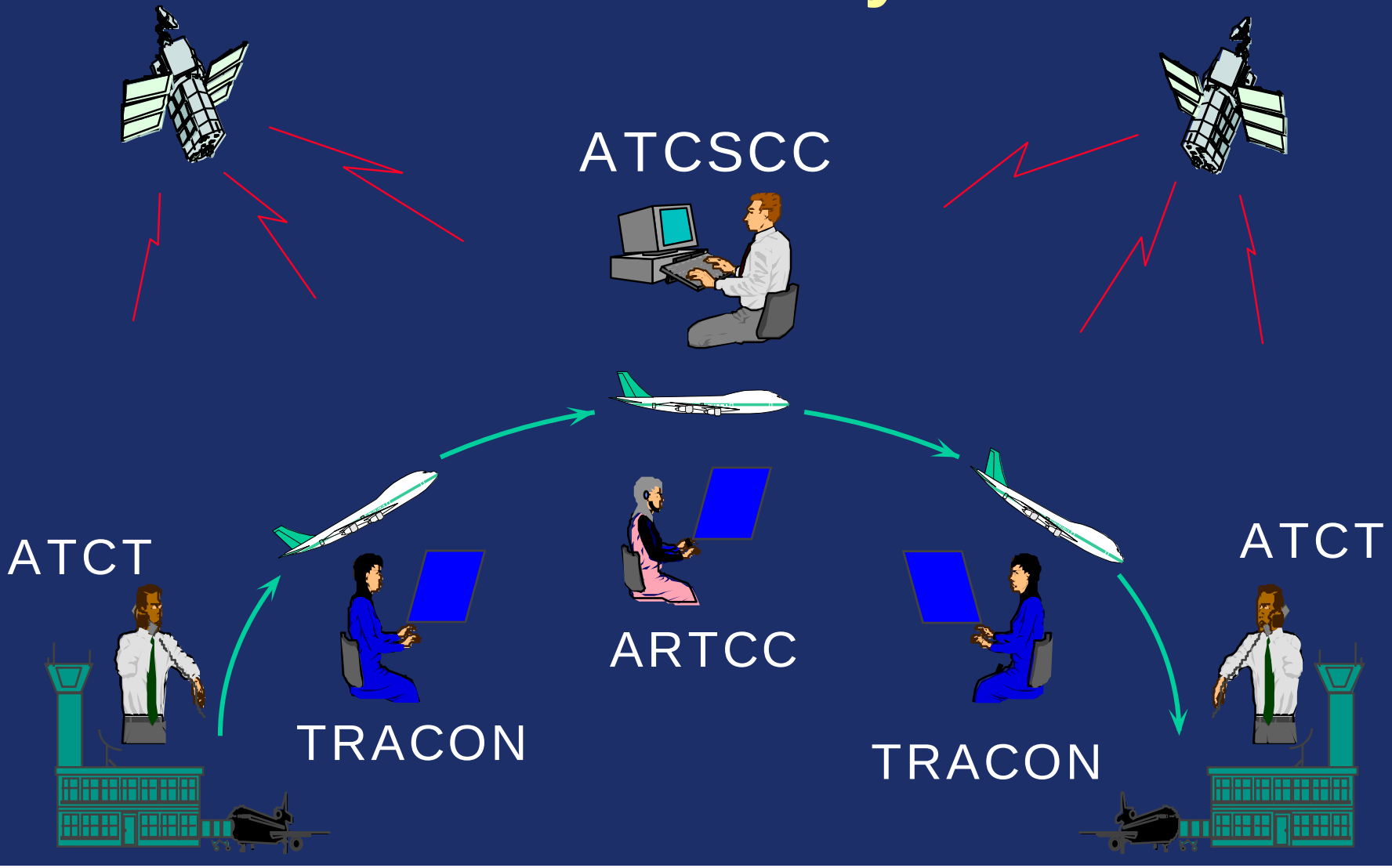
- **44,751,000 Airport Operations**
- **45,795,000 Instrument Operations**
- **46,300,000 EnRoute Operations**
- **809 billion Air Carrier Revenue Passenger Miles**

*Certificated airports serve Air Carrier Operations with aircraft seating more than 9 passengers seats. (FAR Part 139).

National Airspace System - Jet Routes



US Air Traffic Control System



US Air Traffic Control Facilities

Flight Service facilities:

- **76 Flight Service Stations (FSSs)**
  - Under contract w/Lockheed Martin

Terminal facilities:

- **517 Air Traffic Control Towers (ATCTs)**
- **185 Radar Approach Controls (TRACONs)**

Enroute facilities:

- **21 Air Route Traffic Control Centers (ARTCCs)**

Air Traffic Control System Command Center (ATCSCC):

- National air traffic management facility
- Herndon, VA

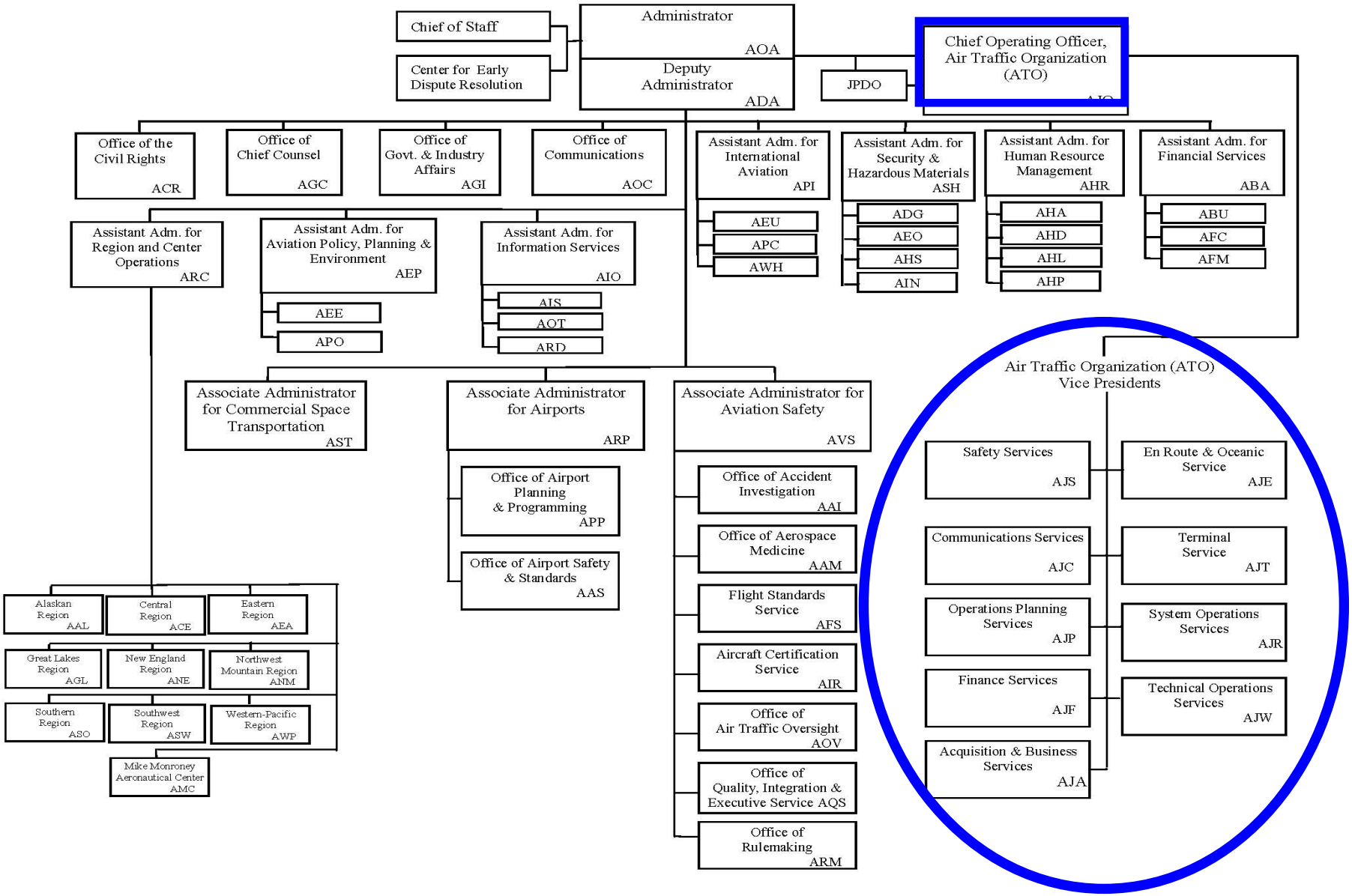
Federal Aviation Administration

FAA part of the US Department of Transportation

- **Employment FY06 - 47,329**
  - Air Traffic Controller Workforce: 17,018
- **FAA Budget FY07: $14.5B**
  - $8.3B Operations
- **Air Traffic Organization (ATO) – A performance based organization within FAA created in 2003. Includes all ATC operations.**

As of October 23, 2006

FEDERAL AVIATION ADMINISTRATION



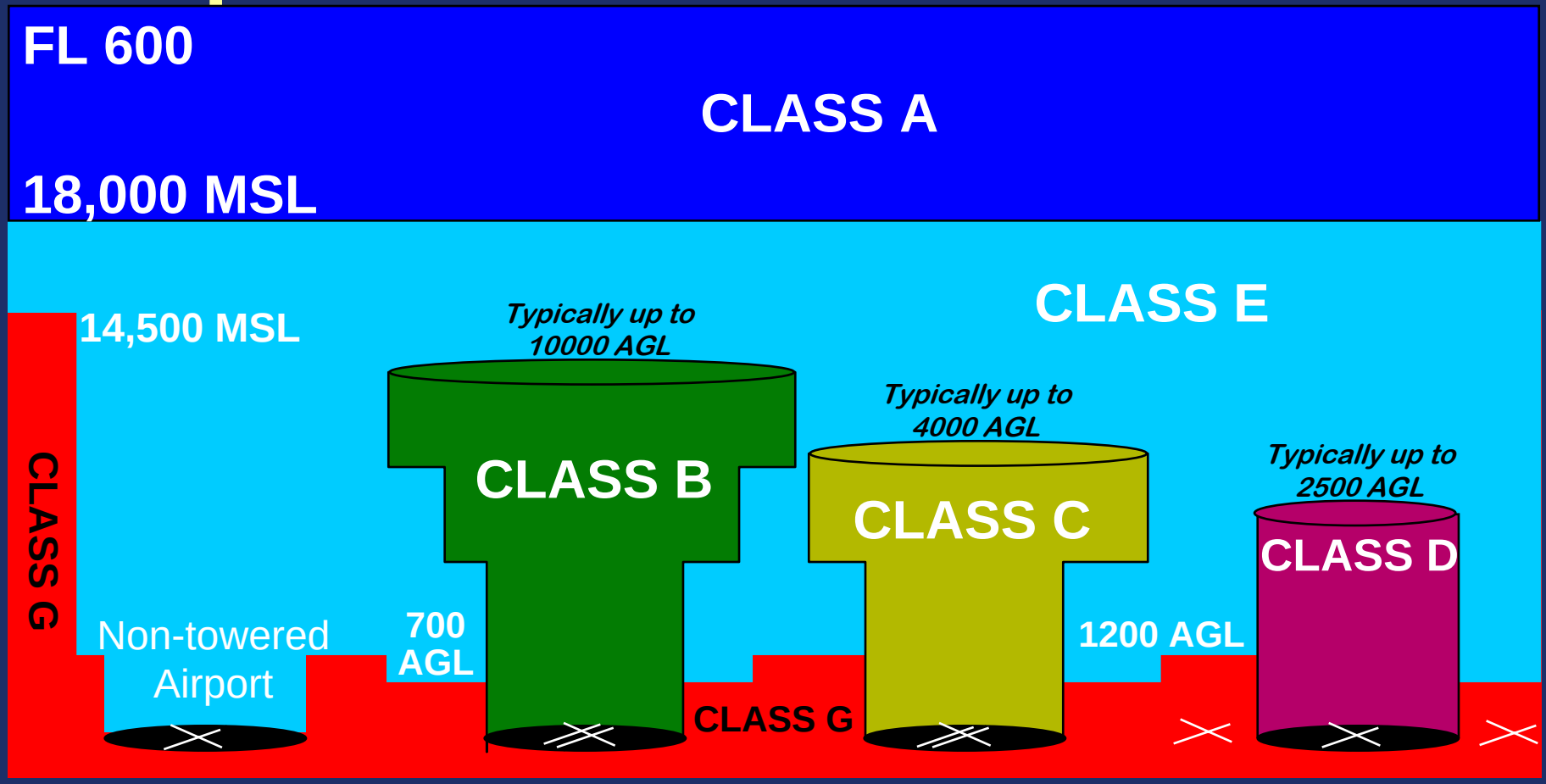
Governing Regulations and Directives

- **Code of Federal Regulations (CFR):**
  - The codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government. It is divided into 50 titles that represent broad areas subject to Federal regulation.
- **Title 14 covers Aeronautics and Space which includes:**
  - Parts 1-499 – Federal Aviation Administration
  - Parts 1200-1299 - NASA

14 CFR - Aeronautics and Space

- **Includes numerous parts also known as Federal Aviation Regulations or FARs**
- **Examples:**
  - Part 1 - Definitions
  - Part 71 – Designation of classes of airspace
  - Part 73 – Special Use Airspace
  - Part 91 - General Operating and Flight Rules
  - Part 121 - Operating requirements: Domestic, flag, and supplemental operations
  - Part 135 - Operating requirements: Commuter and on-demand operations

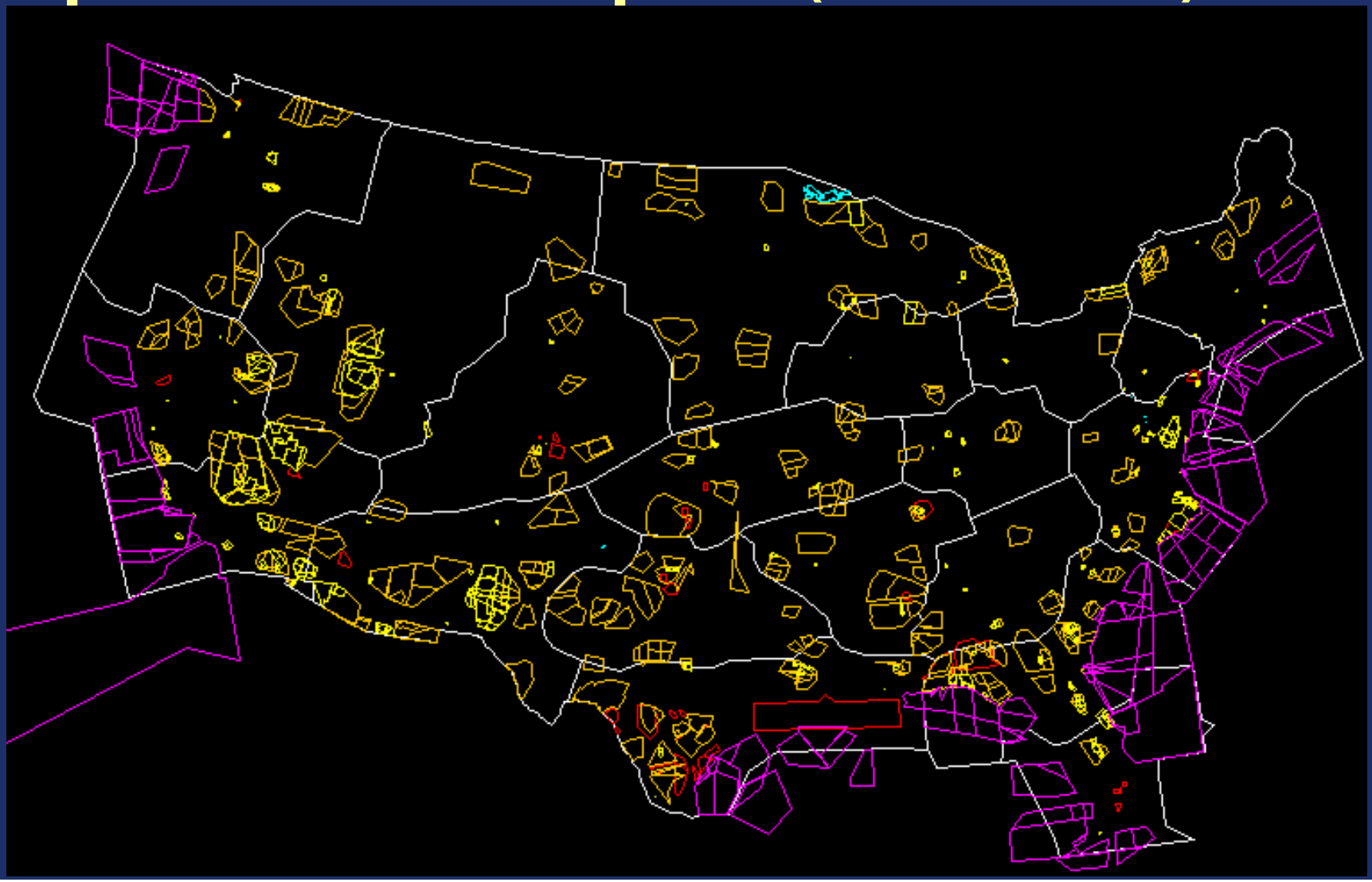
Airspace Classification (14 CFR Part 71)



FL=Flight level
MSL=Mean Sea Level
AGL=Above Ground Level

CLASS G (Uncontrolled Airspace) is virtually all located in the western US

Special Use Airspace (14 CFR Part 73)



General Operating and Flight Rules

14 CFR Part 91

PART 91—GENERAL OPERATING AND FLIGHT RULES

SPECIAL FEDERAL AVIATION REGULATION NO. 50–2
SPECIAL FEDERAL AVIATION REGULATION NO. 60
SPECIAL FEDERAL AVIATION REGULATION NO. 71
SPECIAL FEDERAL AVIATION REGULATION NO. 77
SPECIAL FEDERAL AVIATION REGULATION NO. 79
SPECIAL FEDERAL AVIATION REGULATION NO. 87
SPECIAL FEDERAL AVIATION REGULATION NO. 97
SPECIAL FEDERAL AVIATION REGULATION NO. 104

Subpart A—General

Sec.
91.1 Applicability.
91.3 Responsibility and authority of the pilot in command.
91.5 Pilot in command of aircraft requiring more than one required pilot.
91.7 Civil aircraft airworthiness.
91.9 Civil aircraft flight manual, marking, and placard requirements.
91.11 Prohibition on interference with crewmembers.
91.13 Careless or reckless operation.
91.15 Dropping objects.
91.17 Alcohol or drugs.
91.19 Carriage of narcotic drugs, marihuana, and depressant or stimulant drugs or substances.
91.21 Portable electronic devices.
91.23 Truth-in-leasing clause requirement in leases and conditional sales contracts.
91.25 Aviation Safety Reporting Program: Prohibition against use of reports for enforcement purposes.
91.27–91.99 [Reserved]

Subpart B—Flight Rules

GENERAL

91.101 Applicability.
91.103 Preflight action.
91.115 Right-of-way rules: Water operations.
91.117 Aircraft speed.
91.119 Minimum safe altitudes: General.
91.121 Altimeter settings.
91.123 Compliance with ATC clearances and instructions.
91.125 ATC light signals.
91.126 Operating on or in the vicinity of an airport in Class G airspace.
91.127 Operating on or in the vicinity of an airport in Class E airspace.
91.129 Operations in Class D airspace.
91.130 Operations in Class C airspace.
91.131 Operations in Class B airspace.
91.133 Restricted and prohibited areas.
91.135 Operations in Class A airspace.
91.137 Temporary flight restrictionsin the vicinity of disaster/hazard areas.
91.138 Temporary flight restrictions in national disaster areas in the State of Hawaii.
91.139 Emergency air traffic rules.
91.141 Flight restrictions in the proximity of the Presidential and other parties.
91.143 Flight limitation in the proximity of space flight operations.
91.144 Temporary restriction on flight operations during abnormally high barometric pressure conditions.
91.145 Management of aircraft operations in the vicinity of aerial demonstrations and major sporting events.
91.146–91.149 [Reserved]

VISUAL FLIGHT RULES

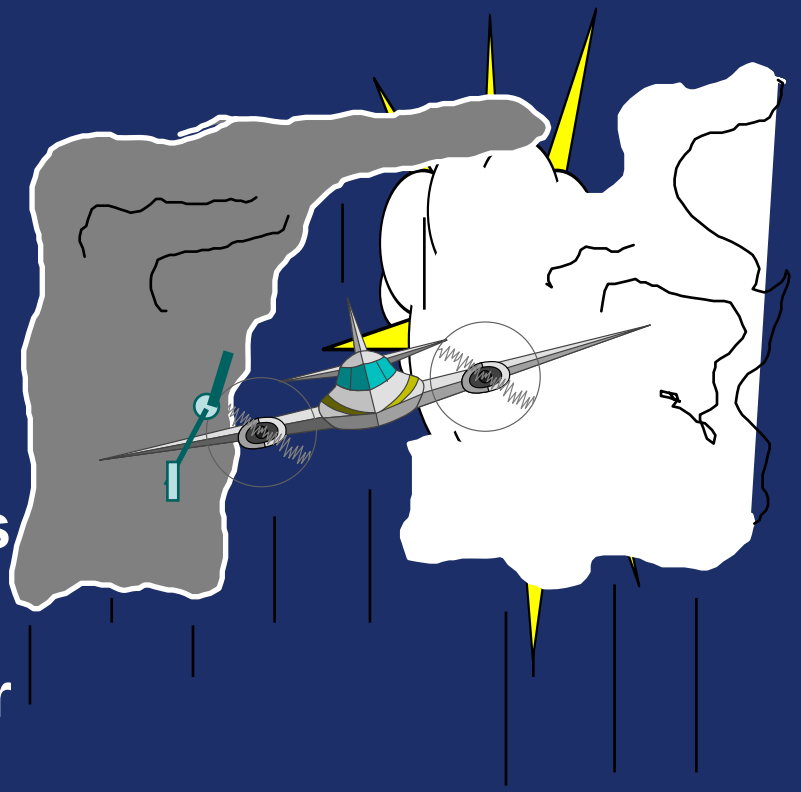
91.151 Fuel requirements for flight in VFR conditions.
91.153 VFR flight plan: Information required.
91.155 Basic VFR weather minimums.
91.157 Special VFR weather minimums.
91.159 VFR cruising altitude or flight level.
91.161–91.165 [Reserved]

INSTRUMENT FLIGHT RULES

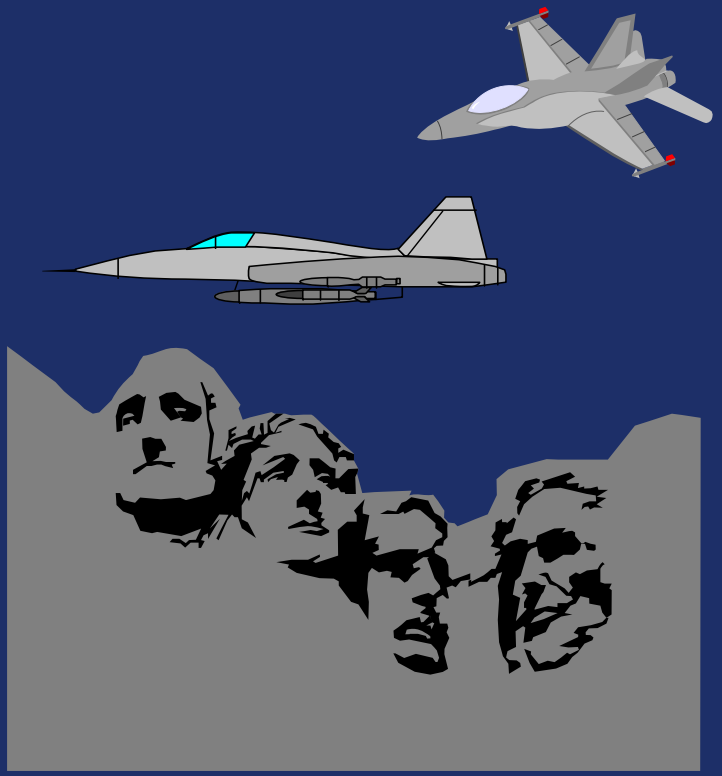
91.167 Fuel requirements for flight in IFR conditions.
91.169 IFR flight plan: Information required.
91.171 VOR equipment check for IFR operations.
91.173 ATC clearance and flight plan required.
91.175 Takeoff and landing under IFR.

Instrument Flight Rules (IFR)
(14 CFR Part 91)

- Flight plan is required
- Contact with ATC mandatory
- Separated from other traffic by ATC
- Can fly in Instrument Meteorological Conditions (IMC) – low or no visibility
- IFR Clearance required for operations in Class A Airspace



Visual Flight Rules (VFR)
(14 CFR Part 91)



- Flight plan is optional
- Radio contact with ATC is voluntary, except in Class B, C and D airspace
- Pilot must see and avoid traffic
- Can fly only in good visibility, remaining clear of clouds
- VFR cloud clearance and visibility minimums vary with type of airspace

Flight Plan (14 CFR Part 91.169)

Pilots file a flight plan describing a precise route:

Instrument Flight Rules (IFR) Flight Plan information required includes:

- Flight description: Callsign, type aircraft, speed, altitude, fuel on board
- Airport Departure Procedure
- Routing Airways
- Airport Arrival Procedure

Weather Briefing / Sources

- **Flight Service Stations (FAA contracted to Lockheed Martin)**
  - Aviation weather reports, forecasts and advisories
  - NOTAMs (Notice to Airmen)
  - Flight plan filing
  - Inflight service via radio communications
- **Natl Weather Service Office**
- **DUAT (Direct User Access Terminal) – FAA contracted online preflight briefing and flight plan filing system**

Key FAA Directives and References

Based on regulations in 14 CFR (FARs):

- **FAA Order 7110.65 – Air Traffic Control**
  - Prescribes air traffic control procedures and phraseology
- **FAA Order 7210.3 – Facility Operation and Administration**
  - Instructions, standards, and guidance for operating and managing air traffic facilities and equipment
- **Aeronautical Information Manual (AIM)**
  - Basic flight information and ATC procedures
  - *AIM information is guidance, not regulation or rule

Air Traffic Control – 7110.65

U.S. Department of Transportation
Federal Aviation Administration

Order 7110.65R

Air Traffic Control

February 16, 2006

Table of Contents

Facility Operation – 7210.3

U.S. Department
of Transportation
Federal Aviation
Administration

Order 7210.3U

Facility Operation and Administration

February 16, 2006

TABLE OF CONTENTS

Part 1. BASIC

Chapter 1. General

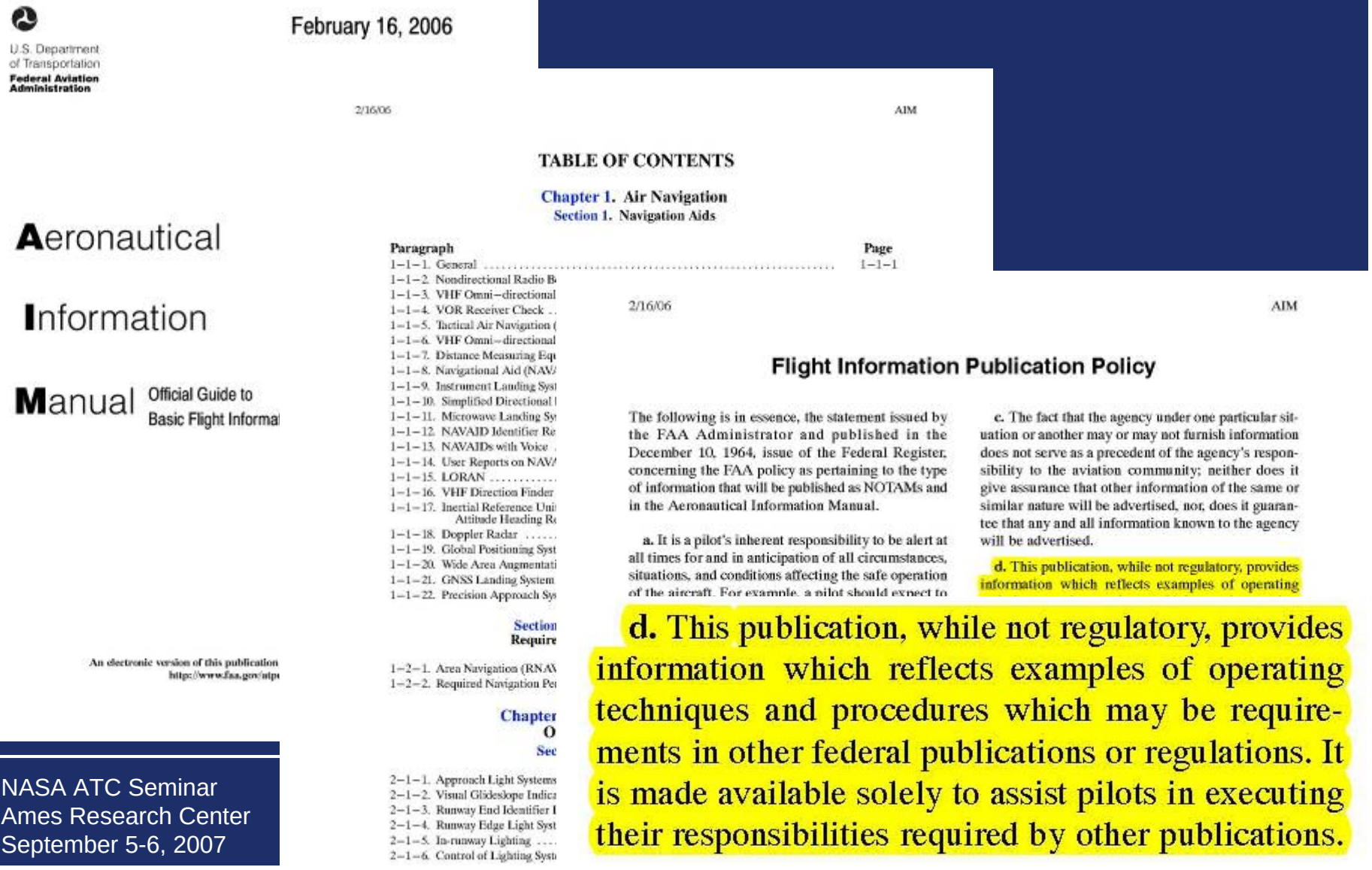
Section 1. Introduction

Section 2. Order Use

Chapter 2. Administration of Facilities

Section 1. General

Aeronautical Information Manual



U.S. Department of Transportation
Federal Aviation Administration

February 16, 2006

Aeronautical Information Manual Official Guide to Basic Flight Informa

An electronic version of this publication https://www.faa.gov/atp

2/16/06 AIM

TABLE OF CONTENTS

Chapter 1. Air Navigation
Section 1. Navigation Aids

Paragraph Page
1–1–1. General 1–1–1
1–1–2. Nondirectional Radio B
1–1–3. VHF Omni–directional
1–1–4. VOR Receiver Check ..
1–1–5. Tactical Air Navigation (
1–1–6. VHF Omni–directional
1–1–7. Distance Measuring Equ
1–1–8. Navigational Aid (NAV/
1–1–9. Instrument Landing Syst
1–1–10. Simplified Directional
1–1–11. Microwave Landing Sy
1–1–12. NAVAID Identifier Re
1–1–13. NAVAIDs with Voice
1–1–14. User Reports on NAV/
1–1–15. LORAN .....
1–1–16. VHF Direction Finder
1–1–17. Inertial Reference Uni
Attitude Heading Re
1–1–18. Doppler Radar .....
1–1–19. Global Positioning Syst
1–1–20. Wide Area Augmentati
1–1–21. GNSS Landing System
1–1–22. Precision Approach Sy

Section
Require

1–2–1. Area Navigation (RNA
1–2–2. Required Navigation Pe

Chapter
O
Sec

2–1–1. Approach Light Systems
2–1–2. Visual Glideslope Indica
2–1–3. Runway End Identifier L
2–1–4. Runway Edge Light Syst
2–1–5. In-runway Lighting ....
2–1–6. Control of Lighting Syst

2/16/06 AIM

Flight Information Publication Policy

The following is in essence, the statement issued by the FAA Administrator and published in the December 10, 1964, issue of the Federal Register, concerning the FAA policy as pertaining to the type of information that will be published as NOTAMs and in the Aeronautical Information Manual.

a. It is a pilot's inherent responsibility to be alert at all times for and in anticipation of all circumstances, situations, and conditions affecting the safe operation of the aircraft. For example, a pilot should expect to

c. The fact that the agency under one particular situation or another may or may not furnish information does not serve as a precedent of the agency's responsibility to the aviation community; neither does it give assurance that other information of the same or similar nature will be advertised, nor, does it guarantee that any and all information known to the agency will be advertised.

d. This publication, while not regulatory, provides information which reflects examples of operating

d. This publication, while not regulatory, provides information which reflects examples of operating techniques and procedures which may be requirements in other federal publications or regulations. It is made available solely to assist pilots in executing their responsibilities required by other publications.

International Civil Aviation Organization - ICAO

- United Nations affiliated aviation body
- Based on Convention on International Civil Aviation (also known as Chicago Convention) signed in 1944
- 189 Contracting States have agreed on numerous aviation conventions governing airspace operation, standardization, technical cooperation, etc.
- The US provides Air Traffic services for ICAO designated Flight Information Regions (FIRs) in the Atlantic, Pacific and Caribbean under ICAO rules.

Key ICAO Directives and References

- **DOC4444, Air Traffic Management**
  - –Procedures for Air Navigation Services
- **DOC7030**
  - –Rules of the Air, Air Traffic Services and Search and Rescue

Reference Link: http://www.ICAO.int

New Challenges in ATC Operations

- **System-wide traffic growth**
  - Growth in emerging markets: LAS (#5), PHX (#7)
  - Growth in Oceanic traffic
- **New Aircraft/Business Models**
  - Very Light Jets, A380
  - Expansion of Low Cost Carrier operations
- **Increase in Unmanned Aerial Systems operations**
  - Government and Commercial
- **Increasing impact of security on NAS operations**
- **Commercial Space Transport activity**

New Technologies/Procedures in ATC

- **ASDE-X – being deployed at 35 major terminals**
- **DRVSM – Implemented in 2005**
- **TMA - now deployed in all ARTCCs**
- **ERAM – En Route Automation Modernization being deployed in FY08**
- **ADS-B – ITT awarded contract 8/31/07 for system deployment by 2013**

New Technologies/Procedures in ATC

- **New Routes**
  - Dual arrival routes (Dual CEDES arrivals)
  - Increased number of departure routes
- **Airspace Redesign**
  - NY/NJ/PHL Redesign project
  - Enroute Sector redesigns

Other Challenges

- **Projected budgetary constraints – user fees**
- **Aging infrastructure (25 year old ground radar systems, 40 year old enroute facilities)**
- **Increased retirements of ATCS (25 years after 1981 strike)**

Next Generation Air Transportation System

- By 2025, U.S. air traffic is predicted to increase two to three times.
- The existing ATC system will not be able to manage this growth.
- NextGen – A highly automated, networked system to improve efficiency, safety and manage future increases in air traffic.
- Joint Planning Development Office (DOT, NASA, DOD, DHS, DOC, OST): a public/private partnership formed to bring NextGen online by 2025.

Seminar Briefings from:

- Air Traffic Control Tower (ATCT)
- Terminal Radar Approach Control (TRACON)
- Air Route Traffic Control Center (ARTCC – aka Enroute): Domestic radar & Oceanic
- Air Traffic Control System Command Center (ATCSCC)

ATC Seminar

Presentations available at:

http://www.as.nasa.gov/atcseminar/presentations.html